EVALUATION OF RETAINED PROCESS OPTIONS
FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
No Action	None	None	No action would be taken and operation of the existing water treatment plant (WTP) would cease. The contaminated area would remain in its existing condition or worsen overtime.	Not Applicable (NA) Consideration required by the NCP.	NA Consideration required by the NCP.	No Cost
No Further Action	None	None	No new action would be taken; the existing WTP would continue to operate and be repaired; however significant upgrades would not be made.	Limited reduction in exposure from the growth of naturally occurring vegetation.	Existing WTP may be approaching end of its practical life.	Low Capital Medium O&M
Institutional Controls	Land Use Controls	Deed/Zoning Restrictions	Permanent record of remaining contaminants of concern (COCs) would be made, and site use prevented or restricted through legally binding requirements such as deed and zoning restrictions. Restrictions would be used to prevent use or transfer of property without notification of limitations on the use of the property.	Potentially effective in preventing disturbance and human contact with contaminated media, but would not provide protection of the environment.	Legal requirements which are readily implemented.	Low Capital Low O&M
	Access Restrictions	Physical Restrictions (Fencing and Posted Warnings)	The contaminated area would be enclosed by fences, berms, and warning signs to control access.	Effective in limiting direct exposure to humans with contaminated solid media.	Readily implemented.	Low Capital Low O&M
	Community Awareness	Information and Education Programs	Community information and educational programs would be undertaken to enhance awareness of potential hazards.	Potentially effective in reducing human exposure to contaminated solid media. Would not protect the environment.	Readily implemented.	Low Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS
FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Monitoring	None	Long-term monitoring of COCs	Periodic monitoring of COCs in groundwater and surface water to check for reduced loadings.	Effective in monitoring migration of COCs to groundwater and surface water, but does not does reduce exposure to contaminated materials.	Readily implemented.	Low Capital Medium O&M
Containment	Covers	Surface Water Controls	See evaluation for Surface Water (Table 2-6)			
		Regrading	Surface and stockpiled material would be regraded for slope stability and enhanced drainage to reduce infiltration and erosion.	Effective in increasing slope stability and runoff of surface water. Not effective at reducing direct exposure to COCs. However, effectiveness increases when used in combination with other containment elements.	Readily implemented.	Low Capital Low O&M
		Vegetative Cover	Establish native vegetation on existing surface soil capable of supporting vegetation. Where existing soil can not support vegetation a growth medium would be placed.	Vegetative cover alone is slightly effective at reducing exposure to and transport of COCs. However, effectiveness increases when used in combination with other containment elements.	May be difficult to get vegetation established. Adequate supply of topsoil may not be readily available.	Low Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Containment (continued)	Covers (continued)	Compacted Soil/Clay Cover	Contaminated material would be regraded and covered with a layer of borrow soil/clay to reduce exposure and infiltration. Includes vegetative cover.	Effective in reducing infiltration and downward migration of COCs. Effective in reducing exposure risk from dermal contact, external radiation, and inhalation of radon. Susceptible to cracking, but clay barrier has self-healing capability for improved long-term effectiveness. May be used in combination with other cover elements.	May be difficult to find a nearby source of clay and/or soil. In addition, mixing of bentonite into existing materials may be difficult because of grain size distribution. Installation becomes difficult with increased slope.	Medium Capital Low O&M
		Multi-Layer Soil Cover	Contaminated material would be regraded and covered with a multi-layer soil cover to reduce exposure and infiltration. The layers may include synthetic geotextiles and geomembranes, clay, soil, rock to block bio-intrusion, and topsoil. Includes vegetative cover.	Highly effective in minimizing the vertical transport of COCs and reducing the exposure risk from dermal contact, external radiation, and inhalation of radon. Least susceptible to weathering and cracking. Clay barrier has self-healing capability for improved long-term effectiveness. May be used in combination with other cover elements.	May be difficult to find a nearby source of clay and/or soil. Installation becomes difficult with increased slope.	High Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS
FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Containment (continued)	Covers (continued)	Asphalt / Concrete Cover {NOT RETAINED}	Contaminated material would be regraded and covered with a single layer asphalt/concrete cap. The surface barrier would reduce direct exposure and infiltration through the waste. Vegetative cover would not be possible.	Susceptible to weathering and cracking. Asphalt / Concrete cover may be used in combination with other cover elements.	Materials are not available near the site. Installation becomes difficult with increased slope.	Medium Capital Medium O&M
		Geosynthetic Clay Liner (GCL) Cover	Contaminated material would be regraded, covered with GCL, and surface soil installed to support vegetation. GCL is a low-permeability liner composed of geosynthetic materials impregnated with clay. The cover would reduce exposure and infiltration. Includes vegetative cover.	Effective in minimizing the vertical transport of COCs and reducing dermal contact. If used as a primary cover type, it would be less effective than a compacted soil/clay cover in reducing radon emissions because it would be thinner. GCL longevity is uncertain, therefore long-term effectiveness may be low. May be used in combination with other cover elements.	Installation becomes difficult with increased slope.	Medium Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Containment (continued)	Covers (continued)	Flexible Membrane Liner (FML) Cover	Contaminated material would be regraded, covered with FML, and a surface soil cover to support vegetation. FML is a geosynthetic material such as high density polyethylene (HDPE), which is installed to create a layer of decreased permeability. Includes vegetative cover.	Very effective in the near term for minimizing the vertical transport of COCs and reducing dermal contact and inhalation of radon. However, the longevity of FML beyond 50 years is uncertain, therefore long-term effectiveness may be low. May be used in combination with other cover elements.	Installation becomes difficult with increased slope.	Medium Capital Low O&M
	Barriers	Retaining Structures	Contaminated material would be physically stabilized by retaining structures such as concrete retaining walls or gabion walls.	Effective in stabilizing surfaces, reducing erosion and the associated transport of mining-affected surface material from the site. May be used in combination with other containment elements.	Readily implemented.	High Capital Low O&M
Excavation, Transport, Disposal	Off-Site Disposal [e]	Existing Off-Site Landfill	Contaminated material including sludge [e] would be disposed at an existing off-site landfill permitted to accept site waste, such as Hanford or Envirocare in Utah. Not considered for waste rock and overburden stockpiles.	Effective in eliminating exposure to stockpiled material and transport of COCs. May not be effective in controlling acid mine drainage (AMD).	The Hanford facility has volume and moisture content restrictions. Both facilities are a long distance from the site.	Very High Capital No O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Excavation, Transport, Disposal (continued)	Off-Site Disposal [e] (continued)	Existing Off-Site Disposal Site	Contaminated material including sludge [e] would be disposed at an existing off-site disposal site permitted to accept site waste. Not considered for Waste Rock and overburden stockpiles.	Effective in eliminating exposure to stockpiled material and transport of COCs. May not be effective in controlling AMD.	Unlikely that disposal site exists with capacity and permitting to accept site waste. If so, it may be a long distance from the site.	Very High Capital No O&M
	On-Site Disposal	Segregation	Contaminated material would be segregated based on concentrations of COCs, radiation emanation (gamma ray screening), or AMD generation potential into stockpile(s) designed to reduce the area requiring a cover or the type of cover.	Effective in segregating material differing in physical and chemical characteristics and reducing the area requiring a cover. Would meet RAOs in combination with other process options.	May be difficult because waste rock piles are mixed with protore.	Medium Capital Low O&M
		Consolidation	Contaminated material would be consolidated within the MA, but outside the open pits, into a stockpile(s) designed to reduce the area requiring a cover.	Effective in reducing exposure pathways and reducing the area requiring a cover. Would meet RAOs in combination with other process options.	Readily implemented.	Low Capital Low O&M
		On-Site Repository / Disposal Area	Contaminated material would be disposed at a new on-site disposal cell. Only retained for disposal of sludge from the WTP.	Effective in reducing exposure pathways.	Topography would limit suitable sites.	High Capital Medium O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Excavation, Transport, Disposal (continued)	On-Site Disposal (continued)	On-Site Repository built to RCRA Subtitle C standards {NOT RETAINED}	Contaminated material would be disposed at a new on-site repository that would be constructed to RCRA Subtitle C standards. Not considered for waste rock and overburden stockpiles.	Effective in reducing exposure pathways.	Topography would limit suitable sites.	High Capital Medium O&M
		Disposal in Open Pits [f]	Surface and Stockpiled material would be relocated to the existing open pits (Pit 3 and/or Pit 4). The open pit(s) may be lined and/or covered for the placement of contaminated materials. If contaminated materials are treated or stabilized they would be placed without a liner. Using the pits for disposal may require removal of water [f]. Not considered for overburden stockpiles.	Effective in reducing exposure pathways to several media and reducing the area requiring a cover. However, lining of the pits has the potential to create "bathtub effect" by preventing water from exiting the pit.	Would likely require handling of surface water in the pit.	High Capital Medium O&M
		Lining of Backfilled Pits {NOT RETAINED}	Temporary removal of waste rock/protore from backfilled pits, installation of liner and drainage system then placement back into pits.	Effective in reducing migration of COCs. Would meet RAOs in combination with other process options. Potential to create "bathtub effect."	Would be complex construction in deep pits that would require double handling of materials and dewatering.	Very High Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS
FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Treatment	Ex-Situ Physical/Chemical	Ex-situ Solidification/ Stabilization (S/S)	COCs are physically bound or enclosed within a stabilized mass in a process performed on site. In general, the process consists of injecting a chemical compound (stabilizing agent) to bind COCs chemically to the soil matrix thereby reducing mobility. There are many distinct types of S/S processes.	Effective in reducing the mobility of metals and radionuclides, although COCs would still be present. May result in increased waste volume and would require treatability testing.	Difficult to implement with the large volumes present at the site.	Very High Capital Low O&M
		Neutralization	Surface and stockpiled material would be chemically neutralized to reduce the potential for AMD through the addition/mixing of lime, waste lime from sugar beet processing, phosphate or other neutralizing agents. Not considered for backfilled pits.	Potentially effective at reducing acid mine drainage by neutralizing pH and the solubility of inorganics. Would require treatability testing.	Readily Implemented, but difficult to supplement neutralization should it become necessary in the future.	Medium Capital Low O&M
	In-Situ Physical/Chemical {NOT RETAINED}	In-situ Stabilization/ Solidification {NOT RETAINED}	Materials containing COCs would be injected with a chemical compound to render the COCs insoluble or bind COCs chemically to the soil matrix.	Effective at reducing mobility of COCs with complete and uniform mixing, but COCs would still be present. Effectiveness decreases with increasing depth of COCs. Likely not effective for waste rock. Would require treatability testing.	Difficult to implement with the type and depth of materials present at the site.	High Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS
FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Treatment (continued)	In-Situ Biological Treatment	Phytoremediation {NOT RETAINED}	Direct use of plants and their associated rhizospheric micro-organisms to remove, degrade, or contain chemical contaminants in soil and groundwater.	Potentially effective for only small portions of site with shallow zone COCs.	May be difficult to get vegetation capable of treatment established with site weather conditions.	Low Capital Medium O&M
		Bio-Solids Application	Materials are stabilized through the addition of bacteria and/or a food (carbon) source for naturally occurring bacteria. This creates an anaerobic environment, which promotes sulfate reducing bacteria. The process reduces the mobility of metals and radionuclides.	Potentially effective for metals treatment. Would require treatability testing to identify effectiveness.	It may be difficult to maintain optimal conditions for bacteria with changing carbon source, and other subsurface conditions.	High Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS
FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Beneficiation / Processing	Resource Recovery	Off Site Milling/Physical Separation	Contaminated materials would be shipped and milled at an existing off site facility. Recovered minerals may have resale value. Considered for sludge and ore/protore stockpiles. Only retained for sludge disposal.	Contaminated material would be transported off site and exposure to these materials eliminated. Creates tailing waste stream that would require additional treatment or disposal.	Difficult to transport large material volumes without existing milling facilities present near the site. Low demand for resources that would likely be recovered. No conventional uranium mills have operated in the US since 2001[g].	Medium Capital High O&M
		On Site Milling/Physical Separation {NOT RETAINED}	Contaminated materials would be milled at a new mill constructed at the site. Recovered minerals may have resale value. Only considered for sludge and ore/protore stockpiles.	Effective in recovering metals and radionuclides. Creates tailings waste stream that would require additional treatment or disposal.	May be difficult obtain approval to construct a mill at the site for temporary operation. Low demand for resources that would likely be recovered.	Very High Capital Medium O&M

EVALUATION OF RETAINED PROCESS OPTIONS
FOR SURFACE & STOCKPILED MATERIAL [a]
Secondary Screening of Technologies and Process Options

{NOT RETAINED} with shading denotes remedial technology process option that will not be carried forward for additional evaluation.

[a] Surface and Stockpiled materials includes backfilled or stockpiled ore, protore, waste rock, overburden, soil, and road materials
[b] Effectiveness rates the technical effectiveness of the process to achieve the remedial action objectives for the medium of concern.
[c] Implementability is based on technical and administrative factors that affect the ability to implement the process.
[d] Costs are based on professional judgment and are relative to process options presented under a specific remedial technology type.
[e] Off-site disposal may also be applicable for residual/secondary wastes (sludge, filters, etc.) generated from water treatment process options presented on Table 2-8.
[f] Process options for water treatment are presented in Table 2-8 should it be necessary to remove water from the pits.
[g] Based on data released in May 2003 on the Department of Energy's Information Administration web site.

Notes: 1) Multiple response actions and remedial technologies may be combined to develop effective alternatives for surface & stockpiled material.

2) Process options retained for additional evaluation may not be applicable to all locations of the site or material types present at the site.

3) Based on the NCP, consolidation/containment remedial technologies are preferred for contaminated material with large volumes and low concentration levels. Smaller volumes of material with higher concentrations are more suited for treatment.

4) If needed, treatability testing could be performed during the remedial design phase.